

**DEVELOPING APPARATUS HAVING A SHEET PREVENTING A  
DEVELOPING  
AGENT FROM LEAKING OUT OF A CONTAINER OPENING**

**Background of the Invention**

**1. Field of the Invention**

[0001]

This invention relates to a developing apparatus mounted in an image forming apparatus such as a photocopier or printer and, more particularly, to a developing apparatus having a sheet preventing a developing agent from leaking out of an opening formed at a developing sleeve.

**2. Description of Related Art**

[0002]

Referring to Fig. 14 and Fig. 15, a conventional developing apparatus is described. Fig. 14 is a cross section showing a conventional developing frame; Fig. 15 is a diagram showing an end of a developing roller when viewed from Arrow X direction in Fig. 14.

[0003]

As shown in Fig. 14 and Fig. 15, a prior art has been disclosed in which an elastic member made of such as felt or rubber is used as a sealing member 114 for sealing a gap between a developing frame 112 and a developing agent carrier, or a developing roller 109c, at the opposite ends in the longitudinal direction of the developing roller 109c in order to prevent toner from leaking out through the gap between the developing frame 112 of the image forming apparatus and the developing roller 109c toward the end in the longitudinal direction of the developing roller. It is to be noted that

although in Fig. 14 it is depicted that there is a gap  $g$  between the developing roller 109c and the sealing member 114, this gap  $g$  exists only where a magnetic sealing member as described below is used as the sealing member 114 and does not exist where a sealing member of a contact type such as a felt or rubber is used. Sealing below the developing roller 109c is performed by contacting, with the developing roller 109c along the longitudinal direction, a tip of a sheet member 115 formed at the developing frame 112. An end of the sheet member 115 in the longitudinal direction is sandwiched between the developing roller 109c and the sealing member made of such a felt or rubber to prevent toner from leaking out of the end in the longitudinal direction. Rotation torque of the developing roller 109c is, in this situation, increased due to sliding contact between the developing roller 109c and the sealing member during developing operation.

[0004]

A sealing member, or magnetic sealing member, has been known, as a sealing member 114 disposed at the end of the developing roller 109c, in which a magnet or magnets are placed with a very small gap  $g$  along an outer periphery of the developing roller to seal the toner as a magnetic body by magnetic force from the magnet or magnets, as shown in Fig. 14 and Fig. 15(b) to reduce the rotational torque. In this situation, the developing roller 109c is not in contact with the sealing member 114, and the gap  $g$  exists as shown in Fig. 15(b). The developing roller 109c therefore does not slide on the sealing member 114 during developing operation, thereby reducing the rotational torque of the developing roller 109c, and thereby rendering extendable the duration period of the developing roller 109c. Such a sealing member is popularly used because enjoying a merit such that can be assembled more easily to the developing frame than other sealing members

made of felt or rubber.

[0005]

In a case where such a magnetic sealing member is used, however, the toner may eventually enter in a space between the developing roller 109c and the sheet member 115 as shown in Fig. 15(b) because the sealing member 114 and the developing roller 109c are not in contact with each other. The toner may deposit on the sheet member 115, and a phenomenon h that the deposited toner pushes down the end of the sheet member 115 occurs. If such a phenomenon h occurs, the sealing capability at the end of the developing roller is reduced, and the toner may be leaked out of the end of the developing roller.

[0006]

To prevent such a falling-down phenomenon at the end of the sheet member 115, an apparatus is formed with a contact auxiliary member for the sheet member arranged on an inner side in the longitudinal direction of the developing roller with respect to the magnetic sealing portion as disclosed in Japanese Patent Application Publication No. Heisei 11-13374. However, with this apparatus, it is turned out that toner leaking to the exterior of the apparatus exists upon passing through a gap between the auxiliary member and the developing frame and passing through a gap between the magnetic sealing member and the developing frame. Furthermore, another toner leaking to the exterior of the apparatus also exists upon passing through a gap between the sealing member and the magnetic sealing portion.

#### Summary of the Invention

[0007]

This invention is made with regard to the above problems, and it is

an object of the invention to provide a developing apparatus capable of suppressing leakage of a developing agent near a magnetic sealing.

It is another object of the invention to provide a developing apparatus comprising: a container containing a developing agent and having an opening; a developer bearing member formed at the opening of said container; a magnetic sealing member magnetically restricting leakage of the developing agent out of an end in a longitudinal direction of said developer bearing member, said magnetic sealing member being formed at the end in the longitudinal direction of said developer bearing member as extending along a circumferential direction of said developer bearing member; a sheet member preventing the developing agent from leaking out of the opening of said container, said sheet member being attached along the longitudinal direction of the container forming the opening, the end in the longitudinal direction of a free end of said sheet member entering in a space between said developer bearing member and said magnetic sealing member; and an auxiliary member holding a free end side of said sheet member around said magnetic sealing member, wherein said container is formed with, at a portion attaching to said sheet member, a recess into which said auxiliary member enters.

[0008]

It is yet another object of the invention to provide a developing apparatus comprising: a container containing a developing agent and having an opening; a developer bearing member provided at the opening of said container; a magnetic sealing member magnetically restricting leakage of the developing agent out of an end of said developer bearing member in a longitudinal direction of said developer bearing member, said magnetic sealing member being formed at the end in the longitudinal direction of said

developer bearing member as extending along a circumferential direction of said developer bearing member; and a sheet member preventing the developing agent from leaking out of the opening of said container, said sheet member being attached with a double side adhesive tape along the longitudinal direction of the container forming the opening, wherein said magnetic sealing member and said sheet member are overlapped with each other, and the double side adhesive tape attaching said sheet member extends to a portion of said magnetic sealing member.

The further objects of the invention will be apparent upon reading the following detailed description with reference to the attached drawings.

#### **Brief Description of the Drawings**

[0009]

Fig. 1 is a diagram showing a process cartridge incorporating a developing apparatus according to the invention;

Fig. 2 is a perspective view showing an appearance of an image forming apparatus (laser beam printer) on which the process cartridge having the developing apparatus is mounted;

Fig. 3 is a structural illustration showing the image forming apparatus;

Fig. 4 is a cross section showing a developing frame of the process cartridge;

Fig. 5 is a diagram showing a positional relation between a developing roller and a magnetic scaling member;

Fig. 6 is a cross section showing a positional relation between the developing roller and an end sealing member;

Fig. 7 is an illustration showing a positional relation among the

developing roller, an elastic sheet, and a sheet lower sealing member;

Fig. 8 is an illustration showing the layout and shape of the sheet lower sealing member according to the first embodiment;

Fig. 9 is an illustration showing a state before the elastic sheet is attached to the developing frame of the first embodiment;

Fig. 10 is an illustration showing a state after the elastic sheet is attached to the developing frame of the first embodiment;

Fig. 11 is an illustration showing the layout and shape of the sheet lower sealing member according to the second embodiment;

Fig. 12 is an illustration showing a state before the elastic sheet is attached to the developing frame of the second embodiment;

Fig. 13 is an illustration showing a state after the elastic sheet is attached to the developing frame of the second embodiment;

Fig. 14 is a cross section showing a developing frame of a prior art; and

Fig. 15 is a diagram showing an end of a developing roller when viewed from Arrow X direction in Fig. 14.

## **Detailed Description of the Preferred Embodiments**

[0010]

Referring to the drawings, embodiments of the invention are described in detail. An electrophotographic image forming apparatus (hereinafter referred to as "image forming apparatus") means what is forming images on recording media using an electrophotographic image forming method. As examples of such an electrophotographic image forming apparatus, electrophotographic photocopiers, electrophotographic printers (e.g., laser beam printers, LED printers), facsimile machines, word

processors are used.

[0011]

A process cartridge is made as a cartridge integrally with an image carrier and any of a charging means, a developing means, and a cleaning means as a processing means operative to the image carrier, and the cartridge is detachably attached to the image forming apparatus body.

[0012]

It is to be noted that the process cartridge B of the invention has, as a combination, a toner frame 11 having a toner container 11a for containing toner, and a developing frame 12 holding a developing means such as a developing roller 9c. The process cartridge is structured in integrating with a photosensitive drum 7, a cleaning means 10 constituted of such as a cleaning blade 10a, and a cleaning frame 13 attaching a charging roller 8.

[0013]

This process cartridge B is formed with an exposing opening 1e for radiating light corresponding to image information to the photosensitive drum 7 and a transfer opening 13a for rendering the photosensitive drum 7 face to a recording medium 2. More specifically, the exposing opening 1e is formed at the cleaning frame 13, and the transfer opening 13a is formed between the developing frame 12 and the cleaning frame 13.

[0014]

#### *First Embodiment*

Fig. 1 is a diagram showing a process cartridge incorporating a developing apparatus according to the invention; Fig. 2 is a perspective view showing an appearance of an image forming apparatus (laser beam printer) to which this embodiment applies; Fig. 3 is a structural illustration showing the image forming apparatus.

[0015]

Image Forming Apparatus

First, referring to the drawings, a laser beam printer A as an image forming apparatus to which this embodiment of the invention applies, is described. This laser beam printer A is, as shown in Fig. 3, for forming images on recording media, c.g., recording paper, OHP sheets, fabrics, through an electrophotographic image forming process. Toner images are formed on a drum shaped electrophotographic photosensitive body (hereinafter referred to as "photosensitive drum 7").

[0016]

More specifically, as shown in Fig. 1, charging is made uniformly on the photosensitive drum 7 with the charging roller 8 as a charging means at the process cartridge B. It is to be noted that this charging roller 8 is driven to rotate as contacting with the photosensitive drum 7. Laser beam corresponding to the image information out of an optical system 1 as shown in Fig. 3 is subsequently radiated to the photosensitive drum 7 through the exposing opening 1e to form latent images. It is to be noted that the optical system 1 includes a laser diode 1a, a polygon mirror 1b, and a lens 1c, and a reflection mirror 1d.

[0017]

The latent images are developed with the developing means 9 in use of toner. The developing means 9 feeds the toner in the toner container 11a to the developing roller 9c serving as a developing agent carrier by rotation of a toner conveyance member 9b. The toner is supplied to the developing region of the photosensitive drum 7 upon rotating the developing roller 9c incorporating a stationary magnetic and upon forming, on the surface of the developing roller 9c, the toner layer to which triboelectric charges are given



by the developing roller 9c. The toner is transferred to the photosensitive drum 7 corresponding to the latent image, thereby visualizing the toner images. A developing blade 9b herein is to restrict the toner amount on the peripheral surface of the developing roller 9c as well as to apply the triboelectric charges. A toner stirring member 9e is attached rotatably around the developing roller 9c to circulate the toner in the developing chamber.

[0018]

In a meanwhile, as shown in Fig. 3, in synchrony with formation of the toner images, the recording medium is conveyed by a conveying means 3. That is, the recording medium 2 set in a feeding cassette 3a is reverse conveyed with a pickup roller 3b, conveyance roller pairs 3c, 3d, and a registration roller pair 3e.

[0019]

Subsequently, the toner image formed on the photosensitive drum 7 included in the process cartridge B is transferred to the recording medium 2 by application of a voltage to a transfer roller 4 as a transferring means. Remaining toner on the photosensitive drum 7 after transfer operation is removed by the cleaning means 10. The cleaning means 10 scrapes the toner remaining on the photosensitive drum 7 by an elastic cleaning blade 10a formed in contact with the photosensitive drum 7 and collects the toner into a waste toner reservoir 10b.

[0020]

The recording medium 2 on which the toner image is transferred is conveyed to a fixing means 5 with a conveyance guide 3f. The fixing means 5 has a drive roller 5c and a fixing roller 5b incorporating a heater 5a. The transferred toner image is fixed upon application of heat and pressure to the

passing recording medium 2.

[0021]

The recording medium 2 is conveyed with delivery roller pairs 3g, 3h, 3i, and is delivered to a delivery tray 6 through a reversing route 3j. The delivery tray 6 is formed on a top surface of the image forming apparatus A as shown in Fig. 2. It is to be noted that after the images are fixed a pivotally movable flapper 3k can operate to delivery the recording medium 2 by a delivery roller pair 3m without passing through a reverse route 3j. In this embodiment, the conveying means 3 is constituted of the conveyance roller pairs 3c, 3d, the registration roller pair 3e, the conveyance guide 3f, the delivery roller pairs 3g, 3h, 3i, and the delivery roller pair 3m.

[0022]

#### Toner's Sealing Member Around the Developing Roller

Next, referring to Figs. 4 to 8, a sealing member for toner around the developing roller 9c is described in detail. Fig. 4 is a cross section showing a developing frame of the process cartridge when viewed in a direction toward the end of the developing roller from a center portion in the longitudinal direction; Fig. 5 is a diagram showing a positional relation between the developing roller and a magnetic sealing member; Fig. 6 is a cross section showing a positional relation between the developing roller and an end sealing member; Fig. 7 is an illustration showing a positional relation among the developing roller, an elastic sheet (sheet member), and a sheet lower sealing member (auxiliary member); Fig. 8 is an illustration showing the layout and shape of the sheet lower sealing member according to the first embodiment.

[0023]

A magnetic sealing member 14 is disposed at the opposite ends of the

developing roller 9c. The magnetic sealing member 14 is disposed with a gap  $g$  to an outer peripheral surface of the developing roller 9c and is mounted on the developing frame 12. The magnetic sealing member 14 is made from a magnetic plate (magnetic member) 14b connected to an outer side surface of a magnet 14a in the longitudinal direction of the developing roller 9c.

[0024]

The magnetic sealing member 14 is further described in detail now. The magnetic sealing member 14 has the magnet 14a as one structural element made of an injection molded product having a width of 3 mm with a nylon binder including of Nd-Fe-B magnetic powder, and the magnetic plate 14b as another structural element made of an iron material having a thickness of 1 mm. Connection between the magnet 14a and the magnet plate 14 is formed by an insertion molding of the injection molding. The connection, however, can be made with adhesive, double side adhesive tape, or attraction force connection solely from magnetic force. The gap between the developing roller 9c and the magnetic sealing member 14 is of 0.1 to 0.7 mm, and the magnetic flux density of the surface of the developing roller 9c at that time is about 1000 to 2000 G from the magnetic force of the magnetic sealing member 14. The positional relation between the magnet 14a and the magnetic plate 14b is that the magnet 14a is placed on an inner side in the longitudinal direction of the developing roller whereas the magnetic plate 14b is placed on an outer side.

[0025]

As other sealing members, the elastic sheet (sheet member) 15 made of, e.g., PET or urethane is arranged at the developing frame 12 along the longitudinal direction below the developing roller 9c, and the tip portion (free

end) thereof is in elastic contact with the developing roller 9c. The end of the elastic sheet 15 in the longitudinal direction of the developing roller is overlapped with the magnetic sealing member 14, and is within the width of the magnetic sealing member 14 (see, Fig. 7). The tip portion of the elastic sheet 15 at that position is located within the gap g between the developing roller 9c and the magnetic sealing member 14. That is, an end of the tip of the elastic sheet in the longitudinal direction of the developing roller enters in a space between the developing roller and the magnetic sealing member. As shown in Fig. 6, an elastic body portion 17 made of such as sponge, rubber or the like, is formed on a side closer to the developing frame with respect to the magnetic sealing member 14. That is, the magnetic sealing member has a magnet portion facing to the peripheral surface of the developing roller and an elastic body portion facing to the container side.

[0026]

As shown in Fig. 7, the sheet lower sealing member (auxiliary member) 16 made of a rubber sponge material is arranged on an inner side of the magnetic sealing member 14 in the longitudinal direction of the developing roller. The sheet lower sealing member 16 is, as shown in Fig. 8, in a letter-L shape when viewed from a top side (an upper side in Fig. 4), and one side 16a of the letter-L is disposed at a recess 12a1 in a side wall 12a attaching the elastic sheet of the developing frame 12. The other side 16b is disposed as extending to a portion at which the elastic sheet 15 comes in contact with the developing roller 9c below the elastic sheet 15, and contacts to the inner side of the magnetic sealing member 14 in the longitudinal direction of the developing roller.

[0027]

Thus, because a part 16a of the sheet lower sealing member

(auxiliary member) 16 enters in the recess formed at the container attaching the elastic sheet (sheet member) 15, this apparatus can restrict the toner from passing through the gap between the auxiliary member and the developing frame (container). In addition, because the sheet lower sealing member 16 is disposed as extending from the recess to a lower portion of a position at which the developing roller 9c and the elastic sheet 15 are in contact with each other where the recess is formed in the side wall 12a of the developing frame 12, the elastic sheet 15 is used for aiding the contact to developing roller 9c in a wide range, thereby preventing the toner from leaking due to entry of the toner between the elastic sheet 15 and the developing roller 9c and due to opening of the gap between the elastic sheet 15 and the developing roller 9c near a portion at which the toner is deposited. By forming the sheet lower sealing member into the letter-L shape, it is prevented that the contact pressure of the elastic sheet to the developing roller is increased too much to remove the toner on the developing roller.

[0028]

#### Attaching Method of Elastic Sheet (Sheet Member) 15

Next, attachment of the elastic sheet 15 to the developing frame 12 is described. Fig. 9 is an illustration showing a state before the elastic sheet is attached to the developing frame; Fig. 10 is an illustration showing a state after the elastic sheet is attached to the developing frame. As shown in the drawings, the elastic sheet 15 is attached to an attaching surface 12b of the developing frame 12 by a double side adhesive tape 15a. The double side adhesive tape 15a is designed to extend longer toward the sheet front end side at the opposite end portions in the longitudinal direction so as to overlap with an elastic body 17 between the magnetic sealing member 14 and the developing frame 12, or namely, an elastic body formed at the magnetic

sealing member on a side of the developing frame. Therefore, the end of the double side adhesive tape in the longitudinal direction is in a letter-L shape.

[0029]

With the above structure, the end in the longitudinal direction of the elastic sheet 15 contacting to the developing roller 9c does not separate from the developing roller by the toner existing in the gap g between the magnetic sealing member 14 and the developing roller 9c, so that the elastic sheet can made contacting to the developing roller stably. This apparatus also prevents the toner from leaking to the exterior of the developing frame 12 upon an entry of the toner through a space between the sheet lower sealing member 16 and the wall 12a1 on the side of elastic sheet attaching surface of the developing frame 12, or namely a space between the sheet lower sealing member 16 and the magnetic sealing member 14 in the longitudinal direction of the developing roller. The double side adhesive tape 15a of the elastic sheet 15 is overlapped to the end sealing member 17, so that leaking of the toner to the exterior of the developing frame between the end sealing member 17 and the elastic sheet 15 is prevented surely.

[0030]

#### *Second Embodiment*

Next, the second embodiment of the invention is described in reference with Fig. 11, Fig. 12, and Fig. 13. Fig. 11 is an illustration showing the layout and shape of the sheet lower sealing member; Fig. 12 is an illustration showing a state before the elastic sheet is attached to the developing frame; Fig. 13 is an illustration showing a state after the elastic sheet is attached to the developing frame. It is to be noted that a description about substantially the same structures to those in the first embodiment is omitted upon providing the same reference numbers.

[0031]

#### Attaching Method of Elastic Sheet 15

Although in the first embodiment the sheet lower sealing member 16 is made in the letter-L shape as the auxiliary member, a sheet lower sealing member 18 as shown in Fig. 11 is in a square shape or rectangular shape when viewed from the top (upper side in Fig. 4) in this invention. A double side adhesive tape 19 as an attaching member for the elastic sheet 15 is extended longer toward the front end side of the elastic sheet 15 across the entire region in the longitudinal direction. In such a case, it should be so set that the elastic sheet does not remove the toner on the developing roller caused by too high contacting pressure of the elastic sheet to the developing roller. With this structure, substantially the same effect can be obtained.

[0031]

This invention is not limited to the above embodiments and includes modifications within the technical conception.